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12. New Chemical Apparatus. *American Journal of Science*, 1868, [2.], XLVI. 51.
13. On the Sulphates of Oxide of Antimony. *American Journal of Science*, 1868, [2.], XLVI. 78.
14. Obituary Notice of Dr. Augustus Matthiessen. *American Journal of Science*, 1871, [3.], I. 73.

THOMAS STERRY HUNT.

THE subject of this notice, whose death occurred in New York City, February 12, 1892, made extensive contributions to American science, and has permanently identified his name with its progress and development. Choosing two of the most rapidly advancing sciences, chemistry and geology, as his field of work, and studying these especially in their intimate and extensive interactions, he had a large and honorable share in giving form to our present knowledge upon these subjects. Although an indefatigable experimenter and an extensive observer, Dr. Hunt was also eminently an original and philosophic thinker, and took an influential part in the establishment of the most matured scientific theories.

Thomas Sterry Hunt was born in Norwich, Conn., on September 5, 1826. His ancestor, William Hunt, was one of the founders of Concord, Mass., in 1635. His maternal grandfather, Consider Sterry, of Norwich, was a civil engineer and mathematician, and was the author of text-books of arithmetic and algebra published one hundred years ago.

While the subject of this sketch was a child, the family moved to Poughkeepsie on the Hudson. There the father died when Thomas, the oldest son, was twelve; and the mother returned with her family of six young children to the old home in Connecticut. For a short time Thomas attended the public school; but it was for a short time only, as he thus early was required to share the burden of the family support, and to seek employment.

At that time his intention was to study medicine. Under the counter of the store in which he was employed he kept a skeleton, as well as his home-made chemical apparatus. Two local physicians assisted the brilliant boy, thus educating himself, by the loan of books.

In 1845 he went to New Haven during the meeting of the Association of Naturalists and Geologists, and obtained work as a reporter on a New York paper. But a more important issue of this trip was a visit to the elder Silliman, whom the boy had met in Norwich after

one of the Professor's lectures. Struck by his precocious proficiency in chemistry and mineralogy, Professor Silliman facilitated his admission to Yale College. Erelong he became paid assistant to Professor Silliman, Jr., who was then making an extended series of water analyses, in which Hunt aided him, and was admitted a member of his household. The struggle for a livelihood had ceased.

While at Yale, between his eighteenth and twentieth years, he contributed eighteen papers to Silliman's Journal, and wrote the Organic Chemistry for Silliman's First Principles. In the Preface to the first edition, published in December, 1846, Professor Silliman acknowledged the aid rendered by his young colleague as follows: "The author takes pleasure in acknowledging the important aid derived in this portion of the work from his friend and professional assistant, Mr. Thomas S. Hunt, whose familiarity with the philosophy and details of chemistry will not fail to make him one of its ablest followers."

In 1847, while preparing to continue his studies in Great Britain, he was appointed to a position on the Geological Survey of Vermont, under Professor C. B. Adams, but soon resigned to accept a similar position on the Canadian Survey. In February, 1847, he entered on his duties as Chemist and Mineralogist to the Geological Survey of Canada, taking possession of that small study and still smaller bedroom opening off the Laboratory in St. Gabriel Street, Montreal, where for so many years he, without any laboratory assistant, not only did the routine analytical work of the Survey, but made many experimental investigations in chemical geology. His literary activity was prodigious, as evinced not only by the scope but by the number of his contributions, no fewer than seventy-six articles appearing under his name in the Second Series of Silliman's Journal alone. It was at this time that he conceived and published those wide views on chemical and general geology which were embodied in the greater works of his later years. His strictly official work as Chemist and Mineralogist would have been more than enough for most men; but he supplemented it by spending several months of each year in the field, and by assisting his chief, Sir William Logan, in the literary and administrative work of the Survey. Every year from 1856 to 1862 he spent the spring months in Quebec, lecturing on chemistry in the French language before Laval University; and for four years he filled the Chair of Applied Chemistry and Mineralogy in McGill University, at Montreal. In 1872 he resigned his position on the Geological Survey of Canada, after a service of twenty-five years,

to accept the Chair of Geology at the Massachusetts Institute of Technology, which he held until 1878.

His eminence in science was early recognized by his election, in 1859, as a Fellow of the Royal Society of London, where for some years he enjoyed the distinction of being the youngest Fellow. Early in his career Harvard conferred on him the degree of M. A., and Laval that of LL. D.; and in 1881 the University of Cambridge, England, also honored him with the degree of LL. D. The names of home and foreign societies which enrolled him on their honor lists would fill a page. He was a member of the National Academy of Science; was Acting President in 1871 of the American Association for the Advancement of Science; and President in 1877 of the American Institute of Mining Engineers. He was the first President by election of the Royal Society of Canada, and held office at every meeting of the International Geological Congress which his health permitted him to attend. His influence at these important conferences was heightened by his perfect familiarity with the French language.

What he considered his most important contributions to science up to 1886, he embodied in two volumes, "Chemical and Geological Essays" (1874), and "Mineral Physiology and Physiography" (1886). His mature views on the nature and effects of Chemism he published in 1887, under the title of "A New Basis for Chemistry"; and he applied the same principles to Mineralogy in his latest work, "Systematic Mineralogy" (1891), based on a natural classification.

From this incomplete sketch of his tireless and many-sided activity we can form some idea of his learning and of his industry. He never knew what it was to be idle, and never wasted his power on irrelevant and desultory work, and thus he became the master of many sciences. He was a good mathematician. Although not himself a profound physicist, he was able to appreciate the more recondite results of modern physical investigations. He felt very keenly those ineffable affinities which bind every energy in nature to one central force, and had a lofty conception of the interdependence of the laws of the universe, and of the harmonious blending therefor of chemistry and physics.

As a geologist, Hunt's original work, whether in the field or in the laboratory, was done among the crystalline rocks. He received his geological training from the Director of the Canadian Survey, Sir William E. Logan; and his text-books were the Azoic rocks to the north of the Lakes and the St. Lawrence, and the Palæozoic rocks of southeastern Quebec. To the knowledge of the stratigraphy thus

gained he added, from his store of chemical and mineralogical knowledge and from his laboratory investigations, the facts and hypothetical deductions which appeared to him to give as conclusive probabilities to the life study of those older barren strata as the evolution of vegetable and animal organisms gives to the history of later rocks. He combined in his intellectual equipment the practical experience of a field geologist with a theoretic erudition in geology and allied science such as few of his fellow workers could claim to possess. He was therefore warranted, as the area of his geological view grew, in shifting his ground on certain subordinate points. The most notable instance of such a change of position was that taken in his Presidential address before the American Association for the Advancement of Science, in 1871, when he subdivided the crystalline rocks which had been previously classed as Laurentian and Huronian into six groups, and altered the stratigraphic relations of what was known in the Canadian Survey as the Quebec Group. Whether the subject was important enough to warrant the vehemence with which he maintained his ground and sustained his argument may, perhaps, be doubted; but to Hunt truth was truth, and the relative proportion and importance of the truth had no weight with him.

It is not on his work as a stratigraphical geologist that Dr. Hunt's fame will mainly rest; but on his achievements in lithology and chemistry, and on the broad generalizations which he drew as to the early development of the earth. There are essays in his second series, elaborating the crenitic theory, which rise to a high pitch of eloquence, and which any one of literary tastes, though utterly ignorant of science, will read with rapt enjoyment. Last year, after completing his "Systematic Mineralogy," and when so feeble that he could only move from his bed to his desk, he commenced a book entitled "The History of an Earth," in which it was his purpose to expand, in a connected treatise, his splendid generalizations on stellar and telluric chemistry, and especially to trace the influence of water under heat and pressure in decomposing the primitive basic crust of the earth, and in creating out of the primary elements the older crystalline rocks, and again in re-creating from their sterile ashes, through decay and death, the newer life-supporting and life-entombing strata which contain, written in generation after generation, the newer history of the earth. But death frustrated this and other literary projects.

Chemistry was Hunt's first love, and he never deserted her. When he studied geology, his impulse was to seek below the visible results of mechanical causes for the all-pervading chemical forces and

agencies which, by dissociation and combination, by integration and disintegration of elemental matter throughout all space, are building up other worlds, as they built up ours. In his system of mineralogy neither outward resemblances, nor similarity of crystalline structure, nor possession of common elements, but the relation of hardness to condensation, and the further relation of these qualities to chemical indifference, constituted the basis for his classification of mineral species. Whether amidst such a multitude of individual species he, in his first arrangement, assigned to each its proper place, may well be doubted, without questioning the substantial correctness of the principle on which his chemical and natural-historical classification rests. Yet it is impossible to follow, in his "Systematic Mineralogy," the beautiful progressive series of quotients deduced from the formula $V = p \div d$ (V being the coefficient of condensation, p the chemical equivalent, and d the specific gravity), as calculated for the species under each genus, without being convinced that Hunt heard and expressed one of those wonderful harmonies of which it is granted to but few mortals to catch the theme, amid the complexity and often apparent discord of nature's contending voices.

The doctrine of the equivalency of volumes, as applicable to liquid and solid species, as well as to the gases, on which is founded Hunt's "Natural System of Mineralogy," had dawned on his mind very early in his chemical studies; but its larger significance was revealed to him only toward the close of his life. To him the domain of chemistry was much wider than it had been held to be under the old conventional theory, which drew such precise lines between chemical and mechanical forces. Like most philosophical chemists of to-day, he regarded all solution as chemical union, and all chemical union as nothing else than solution. In his view all precipitation and all crystallization from solutions involve chemical change, and all chemical species may theoretically exist in a dissolved state, from which they pass into polymeric mineral species, often insoluble. Regarding the same substance in its different polymeric states, due to different degrees of condensation, as representing so many different chemical and mineral species, he, like other chemists, was driven to construct chemical formulas much more complex than those which satisfied the requirements of the Daltonian atomic theory as it had been previously understood.

This New Basis of Chemistry was to Hunt no longer theory, but fact. He had believed for many years that the solid and liquid mineral species known to us are formed by processes of intrinsic condensation, or so called polymerization, from simple chemical species. He

knew, with every chemist, that the determination of the coefficient of condensation is a problem of the highest moment,—a problem which had been neglected in the belief that it did not admit of solution. When, therefore, in 1886, he reached what he regarded as a solution of this insoluble problem, and propounded the theorem that “the volume, not only of gases and vapors, but of all species, whether gaseous, liquid, or solid, is constant, and that the integral weight varies directly as the density,” he rejoiced in the conviction that he had realized and expressed one of the great laws of nature, after which he had been groping all his life.

While throughout all his maturer years he pondered over the deeper problems of pure science, he was also actively engaged in practical pursuits. The papers he has written on technical subjects would fill well-nigh as many volumes as his theoretical and purely scientific memoirs.

It is proper to state that this notice has been, in the main, compiled from those which have appeared elsewhere, and especially from the extended biographical sketch read by Mr. James Douglas before the American Institute of Mining Engineers last June, and published in the current volume (XX.) of the Transactions of the Institute.

JOSEPH LOVERING.

PROFESSOR LOVERING was born to humble circumstances at Charlestown, Massachusetts, December 25, 1813, and received his early education in the public schools of that place. His father, a subordinate town officer, was a member of the Harvard Church, then under the pastoral care of the Rev. Dr. James Walker, subsequently Professor in Harvard College and its President. At the public school, young Lovering had proved himself an apt and bright scholar, and this circumstance led to his employment by Dr. Walker as a reader. The prophetic judgment of this wise man, whom Harvard students so soon after learned to respect and honor, recognized in the lad unusual promise, and he not only encouraged him to prepare for college, but also aided him with personal instruction and advanced the money necessary to pay his college expenses, a loan which he was soon able to repay. In 1830 Lovering entered the Sophomore Class at Harvard, and was graduated in due course in 1833. He was a distinguished scholar, standing fourth in a class which furnished six Professors to the Alma Mater and four to other institutions. At the Commencement he delivered the Latin Salutatory Oration, and three years later, when